CLAIMS

1. A boron phosphide-based semiconductor light-emitting device, which device includes a light-emitting member having a hetero-junction structure in which an n-type lower cladding layer formed of an n-type compound semiconductor, an n-type light-emitting layer formed of an n-type Group III nitride semiconductor, and a p-type upper cladding layer provided on the light-emitting layer and formed of a p-type boron phosphide-based semiconductor are sequentially provided on a surface of a conductive or high-resistive single-crystal substrate and which device includes a p-type electrode provided so as to achieve contact with the p-type upper cladding layer, characterized in that a amorphous layer formed of boron phosphide-based semiconductor is disposed between the p-type upper cladding layer and the n-type light-emitting layer.

2. A boron phosphide-based semiconductor light-emitting device according to claim 1, wherein the amorphous layer has a multilayer structure comprising a first amorphous layer being in contact with the light-emitting layer and a second amorphous layer being in contact with the p-type upper cladding layer and having a carrier concentration higher than that of the first amorphous layer.

3. A boron phosphide-based semiconductor light-emitting device according to claim 2, wherein the first amorphous layer is formed of a boron phosphide-based semiconductor grown at a temperature lower than the temperature at which the light-emitting layer is formed.

4. A boron phosphide-based semiconductor light-emitting device according to claim 2, wherein the first amorphous layer is formed of an undoped boron phosphide and has a thickness of 2 nm to 50 nm.

5. A boron phosphide-based semiconductor light-emitting device according to claim 2, wherein the second amorphous layer is formed of a p-type boron phosphide-

based semiconductor grown at a temperature higher than the temperature at which the first amorphous layer is formed.

6. A boron phosphide-based semiconductor emitting device according to claim 2, wherein the second amorphous layer is formed of an undoped amorphous p-type boron phosphide having an acceptor concentration at room temperature of 2×10^{19} cm^{-3} to 4×10^{20} cm^{-3}, a carrier concentration at room temperature of 5×10^{18} cm^{-3} to 1×10^{20} cm^{-3}, and a thickness of 2 nm to 450 nm.

7. A boron phosphide-based semiconductor light-emitting device according to claim 1, wherein the p-type upper cladding layer is formed of a p-type boron phosphide-based semiconductor having a dislocation density equal to or less than that of the Group III nitride semiconductor serving as the light-emitting layer.

8. A boron phosphide-based semiconductor light-emitting device according to claim 1, wherein the p-type upper cladding layer is formed of an undoped polycrystalline p-type boron phosphide having an acceptor concentration at room temperature of 2×10^{19} cm^{-3} to 4×10^{20} cm^{-3}, a carrier concentration at room temperature of 5×10^{18} cm^{-3} to 1×10^{20} cm^{-3}, and a resistivity at room temperature of 0.1 Ω·cm or less.

9. A boron phosphide-based semiconductor light-emitting device according to claim 1, wherein the p-type electrode provided on the p-type upper cladding layer is formed of a bottom-side electrode and a p-type Ohmic electrode; the bottom-side electrode in contact with the surface of the p-type upper cladding layer and being formed of a material able to form non-Ohmic contact with the p-type boron phosphide-based semiconductor serving as the p-type upper cladding layer; and the p-type Ohmic electrode being in electrical contact with the bottom-

side electrode, extending so as to achieve contact also with the surface of the p-type upper cladding layer, and being in Ohmic contact with the p-type boron phosphide-based semiconductor.

10. A boron phosphide-based semiconductor light-emitting device according to claim 9, wherein the p-type Ohmic electrode is provided so as to extend, as a stripe electrode, on a portion of the surface of the p-type upper cladding layer where the bottom-side electrode is not provided.

11. A boron phosphide-based semiconductor light-emitting device according to claim 9, wherein the bottom-side electrode is formed of a gold-tin (Au-Sn) alloy or a gold-silicon (Au-Si) alloy.

12. A boron phosphide-based semiconductor light-emitting device according to claim 9, wherein the bottom-side electrode is formed of titanium (Ti).

13. A boron phosphide-based semiconductor light-emitting device according to claim 9, wherein the p-type Ohmic electrode is formed of a gold-beryllium (Au-Be) alloy or a gold-zinc (Au-Zn) alloy.

14. A boron phosphide-based semiconductor light-emitting device according to claim 9, wherein the p-type Ohmic electrode is formed of nickel (Ni) or a compound thereof.

15. A boron phosphide-based semiconductor light-emitting device according to claim 9, wherein an intermediate layer formed of a transition metal is provided between the p-type Ohmic electrode and the bottom-side electrode.

16. A boron phosphide-based semiconductor light-emitting device according to claim 15, wherein the intermediate layer is formed of molybdenum (Mo) or platinum (Pt).

17. A method for producing a boron phosphide-based semiconductor light-emitting device, the method including forming a light-emitting member having a hetero-junction

structure in which an n-type lower cladding layer composed of an n-type compound semiconductor, an n-type light-emitting layer composed of an n-type Group III nitride semiconductor, and a p-type upper cladding layer composed of a p-type boron phosphide-based semiconductor and provided on the light-emitting layer are sequentially provided on a surface of a conductive or high-resistive single-crystal substrate, and forming a p-type Ohmic electrode so as to achieve contact with the p-type upper cladding layer, characterized in that the method comprises forming an amorphous layer composed of a boron phosphide-based semiconductor on the n-type light-emitting layer through a vapor phase growth method, and forming the p-type upper cladding layer composed of a p-type boron phosphide-based semiconductor layer on the amorphous layer through a vapor phase growth method.

18. A method for producing a boron phosphide-based semiconductor light-emitting device, the method including forming a light-emitting member having a hetero-junction structure in which an n-type lower cladding layer composed of an n-type compound semiconductor, an n-type light-emitting layer composed of an n-type Group III nitride semiconductor, and a p-type upper cladding layer composed of a p-type boron phosphide-based semiconductor and provided on the light-emitting layer are sequentially provided on a surface of a conductive or high-resistive single-crystal substrate, and forming a p-type Ohmic electrode so as to achieve contact with the p-type upper cladding layer, characterized in that the method comprises forming a first amorphous layer composed of boron phosphide-based semiconductor on the n-type light-emitting layer through a vapor phase growth method; forming a second amorphous layer composed of amorphous p-type boron phosphide-based semiconductor having a carrier concentration higher than that of the first amorphous layer through a vapor phase growth method such that the second amorphous layer is joined to the first amorphous

layer; and forming the p-type upper cladding layer composed of a p-type boron phosphide-based semiconductor layer through a vapor phase growth method such that the upper cladding layer is joined to the second amorphous layer.

19. A method for producing a boron phosphide-based semiconductor light-emitting device according to claim 18, wherein the first amorphous layer is formed on the n-type light-emitting layer maintained at a temperature higher than 250°C and lower than 750°C through a vapor phase growth method at a concentration ratio of a boron-containing compound as a boron source to a phosphorus-containing compound as a phosphorus source fed to a vapor phase growth zone (V/III ratio) falling within a range of 0.2 to 50.

20. A method for producing a boron phosphide-based semiconductor light-emitting device according to claim 18, wherein the second amorphous layer is vapor-phase grown on the first amorphous layer maintained at a temperature of 1000°C to 1250°C at a V/III ratio higher than that employed in vapor phase growth of the first amorphous layer.

21. A method for producing a boron phosphide-based semiconductor light-emitting device according to claim 18, wherein the p-type upper cladding layer is vapor-phase grown at a temperature of 750°C to 1200°C at a V/III ratio falling within a range of 600 to 2,000.

22. A method for producing a boron phosphide-based semiconductor light-emitting device according to claim 18, wherein each of the first amorphous layer, the second amorphous layer, and the p-type upper cladding layer is composed of boron phosphide (BP).

23. A light-emitting diode comprising a boron phosphide-based semiconductor light-emitting device according to any one of claim 1.